REMARKS

Applicant requests reconsideration and further examination of this application.

Regarding the Office Action Summary page of the Examiner's Action mailed on June 16, 2006, the undersigned notes for the record that she believes that box number 8 (Claims 1-4 and 6-10 subject to restriction) was checked in error, and that the Examiner intended to check box 6 (Claims 1-4 and 6-10 rejected).

In response to the Examiner's rejection of Claim 4 under 35 U.S.C. Section 112, second paragraph, this Claim has been amended to delete the phrase containing the objectionable word 'minimized', and to replace the phrase with text drawn from page 7 lines 15-27 of the application as filed. Therefore, no new matter has been added. (It will be noted that the amendment made requires a cavity in the crown of the piston whereas the original claim required the clearance volume to be minimized and therefore exclude any cavity). Applicant believes that the rejection of Claim 4, under Section 112, second paragraph, has been overcome.

Applicant appreciates that indication that Claim 5 is allowable if rewritten in independent format, including the limitations of the base and any intervening claims, and if the rejection under Section 112, second paragraph, is overcome. In response to the Examiner's rejection of Claim 5 under 35 U.S.C. Section 112, second paragraph, the term 'or parallel' has been deleted. Also, Claim 5 has been made into an independent claim, including all of the features of former Claim 1. Therefore, Applicant believes that Claim 5 is now allowable. In addition, a new Claim 11 has been introduced, similar to Claim 5 but directed to the alternative ('parallel') that was deleted from Claim 5. No new matter has been added.

In response to the Examiner's rejection of Claim 10 under 35 U.S.C. Section 112, second paragraph, the phrase containing the objectionable term 'not throttled at part load' has been deleted, and replaced by a phrase with text drawn from page 1 lines 7-8 of the application as filed. Therefore, no new matter has been added, and the Section 112 rejection has been overcome.

In response to the substantive rejections of Claims 1–4, 8 and 9 under 35 U.S.C. 102(b), and of Claims 6-10 under 35 U.S.C. Section 103(a), Claim 1 has been amended to clarify {i} that the combustion chamber is substantially cylindrical, {ii} that the spark ignition means is located at the far end of the combustion chamber, and {iii} the meaning of the term 'helical swirl motion'.

Support for the first of these amendments to Claim 1 is to be found at page 5, line 27, and

page 6, line 23, where it is stated that the chamber is cylindrical, and at page 10, lines 1-3, where it is made clear that the surface of the cylinder can have undulations and/or projections to promote turbulence. The second of the amendments to Claim 1 is taken from Claim 6, and Claim 6 has been deleted as a result. Support for the third of the amendments is to be found at page 2, line 29, to page 3, line 3, for example.

In regard to the second amendment to Claim 1, the Examiner's attention is directed to Fig.3 of the drawings, and the various possible positions of the spark ignition means. The spark ignition means is "located at the far end of the combustion chamber" in both of the positions 9B and 9C shown in that Figure.

As amended, it has been clarified that Claim 1 requires helical swirl motion in which the air jet has a tangential velocity component and an axial velocity component. Whilst both of the prior art documents relied upon by the Examiner (*Rao* and *Gonzales*) disclose a swirling flow, neither discloses or suggests a helical swirl motion.

For the benefit of the Examiner, enclosed herewith, as Exhibit A, are copies of diagrams and supporting text prepared for the Applicant which show helical swirl flow within the combustion chamber. This flow is described in considerable detail in the present application, but it is believed that the enclosed drawings demonstrate the flow in a very concise and clear manner.

The Examiner will note that the timing of fuel injection into the air jet and the stacking effect of the helical swirl flow cause stratification of the fuel within the combustion chamber. It should be understood that achieving successful combustion in a stratified charge engine is a most difficult task that has not previously been solved, despite many attempts and many previous patented inventions. The present invention describes a successful charge stratification invention which has successfully achieved (on the test-bed) spark ignition with an overall air fuel ratio of 140:1 continuously and gradually down to 17:1. No other stratified charge spark-ignited engine has achieved this. The present invention can achieve this very difficult task with one combustion chamber and one fuel injector.

It should be understood that, at part load, in the present invention the early part of the helically-swirling jet of air is impregnated with fuel whilst the latter part is not. This is explained by the wording "some fuel" in Claim 1. In combination with helical swirl motion, and the location of the spark ignition means at the far end of the combustion chamber, this can achieve

stratification of fuel as demonstrated in the attached drawings, in other words having a zone in the combustion chamber which contains burnable fuel and another zone containing air only with no fuel. An engine according to the present invention can control the extent of the fuel zone and air zone gradually over the full load range of the engine.

This is such a desirable engine design (in particular in its ability to reduce fuel consumption) that engine manufacturers would have no doubt developed such an engine by now if the *Gonzales* patent (US 4,765,293 – published in 1988) and the *Rao* patent (US 5,307,772 – published in 1994) led the way to persons skilled in the art by making the invention as previously claimed obvious as the Examiner suggested.

Notwithstanding the Applicant's belief that the amendments which have been made further distinguish the present invention from the cited prior art documents and show the claimed invention to be novel and unobvious, it is believed to be beneficial to consider the cited prior art documents in detail, as follows:

Gonzales describes an engine incorporating a method of stratification in a spark ignition gasoline engine. The stratification is achieved by employing a small indirect combustion chamber where a stoichiometric mixture is spark ignited and the flame is then used to ignite lean mixtures in a larger combustion chamber housed in the piston. Experienced engine designers will be well aware that the problem with such two-chamber stratification is that it can never reach very lean air fuel ratios since the small chamber will require stoichiometric mixture to allow spark ignition therein. If, for example, the small chamber is one third of the combustion volume and the large chamber two thirds of the combustion volume, the leanest overall air/fuel mixture will be 45:1 (i.e. 3 x 15:1), as compared to an engine according to the present invention which can achieve 140:1.

In addition, *Gonzales* uses a spherical chamber whereas in Claim 1 as now amended the present invention uses a cylindrical chamber, which is necessary to promote the required helical swirl motion.

The prior art document of *Rao* primarily describes a compression ignition engine and its main innovation is the use of a catalyst in the orifice. The catalyst is located upon a honeycomb in the orifice, which honeycomb will reduce the intensity of the air jet and is contrary to the present invention where the orifice is not constricted in any way (and as indicated at page 8 lines 27-29 in the present invention it is desired to maximize the area of the orifice in order to reduce

pumping losses). Constricting the orifice with the catalyst-covered honeycomb structure will significantly increase pumping losses, but is necessary in *Rao* to achieve the catalytic action required.

Compression ignition engines do not require stratification and *Rao* offers no mechanism to promote stratification when applying the device to the spark ignited gasoline engine in his Fig.8. Thus, unlike the present invention, *Rao* does not describe a mechanism that can promote stratification of the air/fuel mixture in a spark ignition engine. It is believed that this is because compression ignition engines such as diesel to which the disclosure of *Rao* is primarily directed can operate lean since any amount of fuel will ignite spontaneously once injected into hot air. Spark ignited engines on the other hand must provide a stoichiometric (or near stoichiometric) mixture at the spark plug and *Rao* does not describe or suggest how such a mixture is provided at the spark plug and a different (leaner) mixture is provided elsewhere.

Rao's remark at column 3, lines 3-9, that those skilled in the art can apply his principle to lean burn spark gasoline engines is merely speculative and simply not correct. There is no description or suggestion in his patent as to how to achieve lean burn capability (i.e. how to allow a spark plug to ignite a lean mixture without stratification - it is physically impossible with known spark technology). If *Rao's* remark was correct, then engine designers would have solved the problem facing the present inventor soon after 1994.

Applicant believes that Claims 1-5, and 7-11 are novel and unobvious. Applicant believes that the application is in condition for allowance and respectfully requests the same.

Respectfully submitted,

Barbara Pedersen Date: 8/1/06

Ken J. Pedersen, Registration No. 29,689
Barbara S. Pedersen, Registration No. 36,237
P.O. Box 2666
Boise, ID 83701-2666
Telephone: 208-343-6355
Facsimile: 208-343-6341